1.0 PURPOSE/SCOPE:

To assure that the Ultra-Sonic Thickness Gage used to measure quality characteristics is accurate and in good working condition and the accuracy is verified at appropriate frequencies. Any production or testing facility using an Ultra-Sonic Thickness Gage will follow this procedure

2.0 RESPONSIBILITY:

It is the responsibility of each person who uses the equipment to make sure the test equipment is calibrated and in good working condition. Also the Plant Manager and Lab Manager is responsible for making sure that the test equipment is calibrated per the frequency required personally or by designating a qualified person.

3.0 SAFETY:

Not applicable

4.0 PROCEDURE:

1. Based on Table 1 of SOP: # 7.14 check the Ultra-Sonic Thickness Gage at least 1/6 month. a qualified Plant or Lab person should be designated to do this.

2. Turn the Ultra-Sonic Thickness Gage on. Check the end of the probe to make sure there is no dirt or build up of material. It is a good idea for the operator of the gage to do this at each use.

3. Record the gage number and description of the gage in the calibration log book (see calibration log for examples). Record all other information that is asked for on the log when calibration is complete. The transducer probe must be identified as being part of the ultra-sonic gage. Each transducer head has a serial number on the flat surface. Use this number and tie it to the main gage number when doing calibrations. For example if you have two transducer haeds then each will have its own serial number. In your calibration book make sure that each gage is calibrated separately with each transducer. In the gage description show the gage number plus transducer serial number for each calibration. You may have to purchase a magnifying glass to read the numbers.

4. Using a micrometer that has been calibrated, measure several pieces of plastic pipe with varying thickness' that represent close to the thinnest cross section to approximately the thickest cross-section plus a thickness around to the center of the range. For example: find a cross section of pipe that is close to .025" (thinnest), one that is approximately .300" (thickest), and a cross section of approximately .150".

5. Write the dimension on each piece of pipe and circle the area where the measurement occurred. This will serve as the operators "working standard" and also as the pieces to calibrate the gage to.

6. To calibrate the gage, follow the manufactures calibration procedure located on page 3-3 to 3-4 of the Ultra-Sonic Thickness gage instruction manual. See attachment "A". The gage will be considered acceptable if the reading results are within +/- .002 of the Micrometer readings.

7. Once completed and verified that the gage measures correctly, then put a new sticker or other form of identification on the gage or its holder indicating the following information:

   Gage #:
   Cal. Date:
   Next Cal. Date:
   Cal. By:

8. If a gage is found to be out of calibration, do not use in production or testing until the gage can be corrected. Call the Central Lab for instructions. Place a red tag on the gage and mark as **"do not use".**

9. During normal use, it is good practice to make sure the gage is clean. The operators should use their "working standards" to verify the gage is still in calibration.

5.0 RELATED DOCUMENTATION:

1 Calibration Log - form # 250
2 SOP# 7.14
3. Panametrics Instruction Manual

6.0 CHANGE HISTORY:

This document was originally issued on August 23, 2000. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
5-8-01	Changed Issued by Art Suydam to Quality Team. Changed	1
	Approved by: to Art Suydam	
8/16/01	Changed Gage number	2
7/29/03	Text Regarding attached form	3
9-29-04	Added verbiage in Step 3 and 4 regarding identifying transducer with gage.	4
4-20-05	Step 3 use the serial number on the transducer head and tie this number to calibrations of the unit.	5

1.0 PURPOSE/SCOPE

The purpose of this instruction is:

- to determine the % ash (carbon or TiO_2) $_{in}$ purchased concentrates or in-house pipe or fittings.
- to make a mixture of pyrogallol for use with the carbon burn-off section of this instruction.
- to establish a procedure for cleaning porcelain boats after they have been used in the % ash test.

All concentrates will be sampled prior to use and percentage of colorant will be checked to specification.

2.0 EQUIPMENT DESCRIPTION

- For % Ash Test: Mettler Balance, Lindberg Furnace, tweezers, porcelain boats, tin tray, 1 foot long wire, and desiccator
- For pyrogallol mixture: glass beaker, tin tray, stirring rod/stick, and shadowgraph scale
- For porcelain boat cleaning: muffle furnace, tweezers, tissue, desiccator, temperature indicator

3.0 RESPONSIBILITY

The lab technician is responsible for testing material in accordance with this procedure. The lab technician has the authority to determine disposition of material based on the tests/results.

4.0 SAFETY

1.0 The lab technician is responsible for following all Hancor Safety Guidelines and specific safety requirements called out in this test procedure.

2.0 The use of safety glasses, and gloves are required for the mixing of the pyrogallo solution.

3.0 THIS PROCEDURE INVOLVES VERY HOT TEMPERATURES. AVOID TOUCHING SURFACES WITHOUT THE USE OF TWEEZERS.

5.0 PROCEDURE

A) <u>Pyrogallol Mixing (For use in step 10.0)</u>

1.0 Add 100 ml of distilled water to a glass beaker.

2.0 Weigh an empty tin tray on the shadowgraph scale.

3.0 Measure out 5 grams of pyrogallol on the tray. Add the pyrogallol to the water in the glass beaker and stir.



4.0 Measure out 50 grams of potassium hydroxide on the tin tray. Add to the water & pyrogallol mixture and stir. Mix until all of the potassium hydroxide and pyrogallol is dissolved. The mixture will react and turn to a dark color.



5.0 Keep mixture in a covered beaker until ready for use.

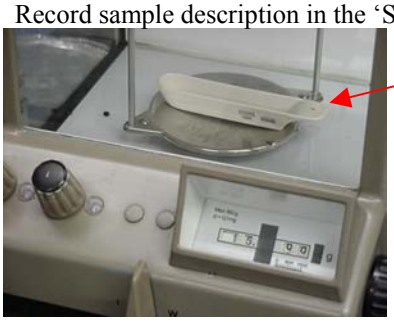
B) <u>% Ash Burn-Off (Carbon Test</u>

1.0 Turn on Linberg furnace until heated to 539^0 C. (1000^0 Fahrenheit)

2.0. Using tweezers, remove a clean porcelain boat from the Desiccator.

3.0 Quickly weigh the boat on the Mettler Balance to the nearest 0.001-gram. Record this weight in the '% Ash' Notebook under Column 1—'Empty Boat Weight'. (See picture in step 4.0.)

4.0 With the boat still on the balance tray, add 1 gram of material to be tested, weigh to the nearest 0.001 gram, and record the weight in the '% Ash' Notebook under column 2 – 'Boat and Sample Weight'. Record sample description in the 'Sample Description' column.



Weigh porcelain boat.

Add 1 gram of test material.

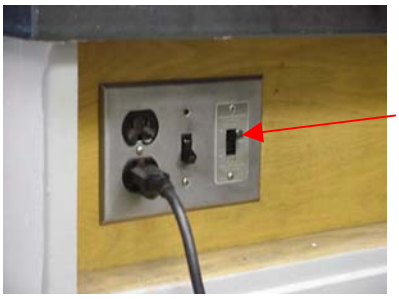
5.0 Using tweezers carefully remove the boat(s) from the Mettler Balance and place the boat(s) on the tin tray. Carry the tin tray to the Lindberg Furnace area.

6.0 Open the furnace and place the glass tube into the cradle of the furnace. (See picture in step 7.0.)

7.0 Use the tweezers to pick up the boat and place it into the end of the glass tube. Use a foot-long wire to push the boat towards the center of the glass tube.

8.0 Place the rubber stopper (with the plastic hose attached) into the end of the glass tube. Close the Furnace. (See picture in step 7.0.)

9.0 Close the sliding window on the booth and turn on the exhaust fan located on the lower left-hand corner of the booth.



Switch for exhaust fan

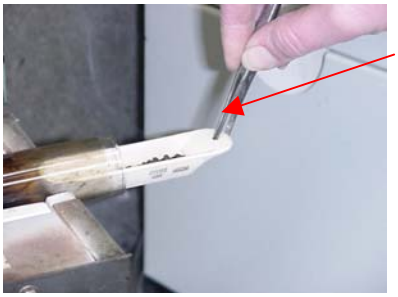
10.0 Confirm that there is enough pyrogallol in the tube where the nitrogen flows through (see picture). There is a black line on the test tube to indicate the proper level. If more is needed, add more to the tube from the supply made in procedure 5A. Slowly turn on the Nitrogen gas by turning the knob on the tank counter-clockwise. The pyrogallol in the glass tube should be bubbling, indicating that the nitrogen is properly flowing from the supply tank.

Turn on Nitrogen gas.

Pyrogallol Bubbling

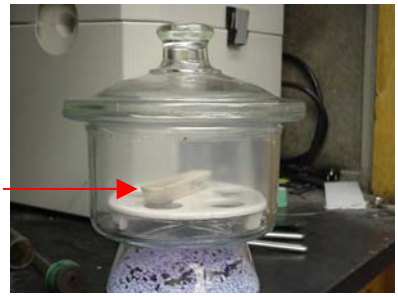
11.0 Set the timer for fifteen (15) minutes.
(It is acceptable for the boats to remain in the oven longer than 15 minutes.)

12.0 When the timer goes off, remove boats from glass tube (remember surfaces are very hot), turn off the Lindberg Furnace, exhaust fan, and nitrogen (unless you have additional testing to do), and place the boats in the Desiccator. Allow the boats to cool for a minimum of 15 minutes.



Remove boat from glass tube with tweezers.

Place boat in desiccator.



13.0 Place glass tube back on the wire rack located inside of the hood, next to the furnace.

14.0 When the porcelain boats have cooled, use the tweezers to place the boat onto the Mettler Balance and weigh to the nearest 0.001-gram.
Record this weight in the % ash Notebook under column 3 - Weight of Boat and Sample After Test.

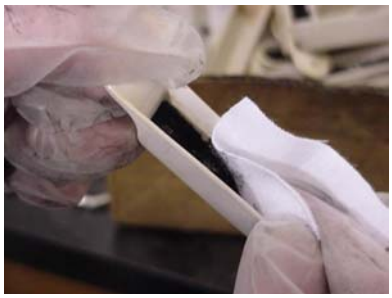
15.0 Use the following formula to calculate % ash:
(This formula is also found in the Lab Restricted file under calculations)

$$\frac{\text{weight in column 3 - weight in column 1}}{\text{weight in column 2 - weight in column 1}} \times 100 = \%\ \text{ASH}$$

16.0 Record this value in column 4 – '% Ash Result'.

C) <u>Porcelain Boat Cleaning</u>

1.0 Clean used boats with tissue or gun patch over a wastebasket.



2.0 After boats are cleaned, place them in the Muffle Furnace. Fill the Muffle Furnace as full of boats as possible, randomly stacking each row of boats to insure proper cleaning.
<u>Note: Boats are fragile -- handle with care</u>.

3.0 Close the door of the Muffle Furnace. Turn the top dial to "ON" (100) position. Turn the bottom dial to "HIGH".

Turn to "ON" (100).

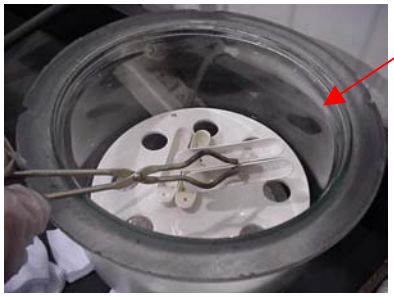
Turn to "HIGH".

4.0 Muffle Furnace should reach approximately 1500 ^{o} F. This will take about 4 hours. Use the digital read-out temperature gauge for temperature verification.

5.0 After 4 hours or when the furnace reaches 1500 ^{o} F, turn the furnace off.

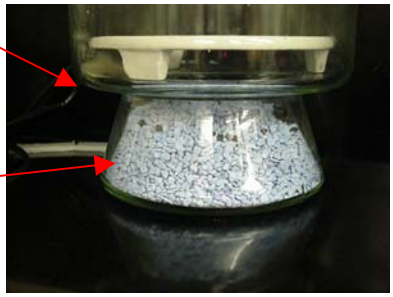
6.0 Do not open the door of the furnace until it has reached room temperature (72 - 82 ^{o} F). This will take approximately 12 hours.

7.0 Once the temperature reaches room temperature, take the boats out of the furnace using the tweezers and immediately place the boats in the desiccator. (Check the "Drierite" (anhydrous calcium sulfate) in the desiccator for the correct color (blue). If pink in color, do not use and replace the desiccator with one that has blue "Drierite" anhydrous calcium sulfate.



Desiccator

"Drierite" Anhydrous Calcium Sulfate (Blue)



8.0 **Keep** the boats in the desiccator until they are to be used for % ash testing.

6.0 RELATED DOCUMENTATION

6.1 ASTM D 1603 - "Test Method for Carbon Black in Olefin Plastic"
6.2 "% Ash" Notebook

7.0 CHANGE HISTORY

This document was originally issued on October 10, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
7/23/01	Changed document number from CL-02 to LAB-WI-02	1
8/6/01	Changed Issued by from Art Suydam to Quality team	2
9-19-02	Updated photos with new furnace and instructions	3
3-23-05	Removed photo of flow meter for the nitrogen flow.	4

1.0 PURPOSE/SCOPE

The purpose of the NCLS test is to determine the breaking-point time for plastic in an IGEPAL solution in a controlled environment. The purpose of this instruction is to conduct an NCLS test by following the instructions outlined below:

- Drain and fill NCLS tank with IGEPAL solution.
- Prepare NCLS test samples.
- Verify the dimensions of the NCLS test samples and enter the measurements in a computer spreadsheet (Excel).
- Prepare weights according to the applied force required for each testing sample. The applied force will be based in part on the given tensile strength of 4000 psi which is already embedded in the NCLS worksheets.
- Verify the correct density of IGEPAL solution.
- Test samples in the NCLS machine.

2.0 EQUIPMENT DESCRIPTION

- NCLS Machine, Carver Presses, 2-ton Arbor Press & "cookie cutter", Instron, Microscope, Micrometer, Hydrometer, and Shadowgraph.

3.0 RESPONSIBILITY

The lab technician is responsible for testing material in accordance with this procedure. The lab technician has the authority to determine disposition of material based on the tests/results.

4.0 SAFETY

1.0 The lab technician is responsible for following all Hancor Safety Guidelines and specific safety requirements called out in this test procedure.

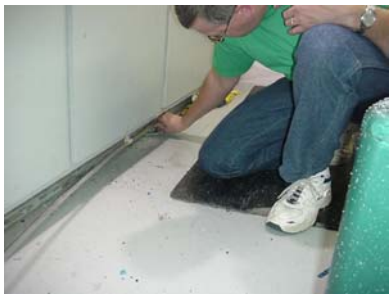
2.0 The use of safety glasses and gloves is required for this testing procedure

3.0 **Use** extreme caution when handling IGEPAL. Refer to MSDS sheets for further information.

5.0 PROCEDURE

A) Draining and Filling the NCLS Tank

1) Drain the NCLS tank by attaching a hose on the bottom of the plug on the back of the tank. Place the other end of the hose in the drain.



2) Loosen the drain plug on the back of the tank (see picture in step 1).

3) Remove the plastic balls from the tank and store them in a plastic or plastic-lined container.

4) Fill the tank with 22 ½ gallons of water. Add 2 ½ gallons of IGEPAL, add the plastic balls, and turn on the agitator.

5) The temperature of the IGEPAL must reach and be maintained at 50 degrees Celsius. (Use thermostat adjuster on the machine.)

B) Verifying The Correct Density of IGEPAL Solution

1) Using a hydrometer, verify the density of IGEPAL solution by pouring 500ml in a beaker. The reading on the hydrometer should be 1.007 g/cc.

2) If the density reading is too high, add more IGEPAL. If the density reading is too low, add more water.

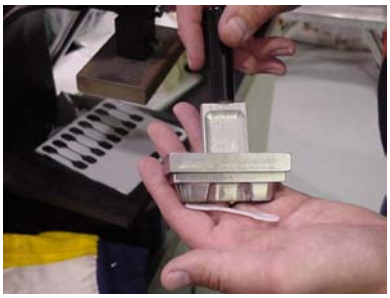
3) Maintain IGEPAL solution by storing water in the plastic container stored above the machine. This water is used to maintain a consistent level of IGEPAL /water in the tank. (As the solution in the tank evaporates, a float will sink and activate the flow of more water until the proper level of solution (25 gallons) is reached.)

C) Preparing NCLS Test Samples

1) Make 5”x5” plates according to the ‘Compression-Molding of Tensile, Flex, & Izod Specimens’, LAB-WI-03 Set plates aside for 40 hours.

2) Cut out 8-10 NCLS ‘dog bones’ (samples) by using the 2-ton Arbor Press and NCLS ‘dog bone cookie cutter’. Maintain the identification of the NCLS samples.

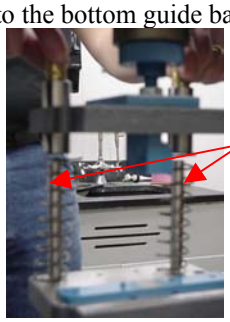
3) Use the ‘specimen-removal tool’ to remove the cutout plastic from the ‘cookie cutter’.



4) Take the cutout 'dog bones' (samples) to the lab area with the Instron.

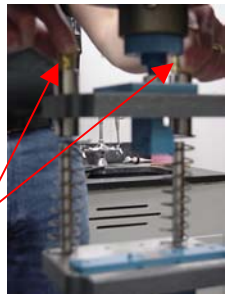
5) Assemble the NCLS test fixture on the Instron. Add springs and ball bearing sleeves to the assembly and lower the top fixture onto the bottom guide bars.

Upper & Lower Parts of Fixture



Springs

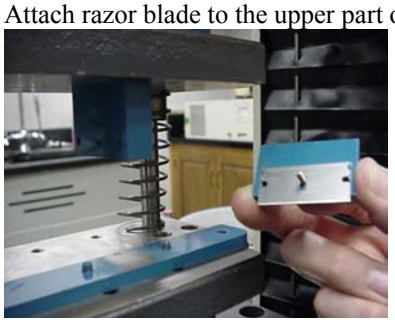
Ball Bearing Sleeves

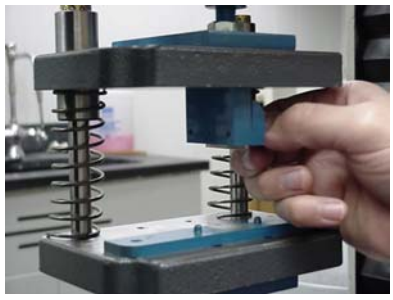


6) Remove tab from razor blade.

Before After

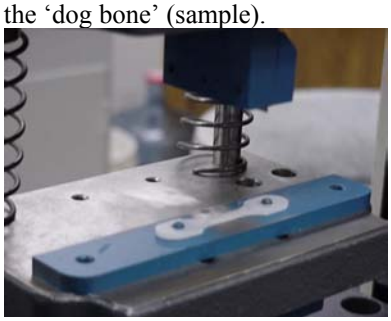
7) Attach razor blade to the upper part of the fixture.





8) Ream the holes in the 'dog bones' (samples) with a drill bit.

9) Lay a 'dog bone' (sample) in the fixture by lining the pins in the lower fixture with the holes in the 'dog bone' (sample).



10) Lower the upper fixture until the razor blade barely touches the 'dog bone' (sample). Use the 'Fine Position' knob until the blade touches down on the sample (no light gap).

11) Start the Instron Software Program.

12) Open the "NCTL.mrd" file.

13) Select "Flexural" in the top right area of the screen.

14) Select "03 NCTL" under the "Choose Test Method" area of the screen.

15) Select "OK".

16) Select "Start Test" under 'Menu' on the title bar and select 'OK'.

17) 'Zero out' the machine by pushing the 'Reset GL' button and then by pushing the '#1' button on the Instron keypad.

18) Select "OK" at the 'Warning' prompt on the computer.

19) The computer will display the amount of depth the razor blade penetrates the 'dog bone' (sample). When the depth reaches -0.0130, stop the machine by selecting 'Stop Test'.

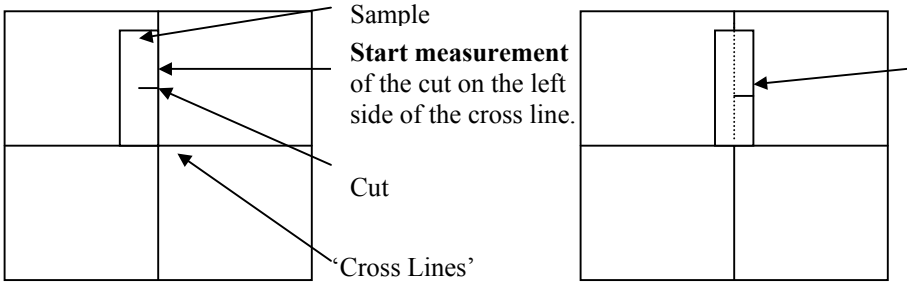
20) After raising the top part of the fixture, remove the sample. Take the sample to a microscope to verify the proper depth of the cut.

21) Note: Replace razor blade after 10 samples have been cut.

D) Verifying The Proper Depth of The Cut

1) Place the sample in a sideways position in the micrometers holding fixture on the microscope. The cut side should face to the right.

2) Line the top of the cut on the left side of the cross lines (seen through the microscope). Move the sample in the holding fixture by turning the spindle on the micrometer until the bottom of the cut reaches the right side of the cross line.



Micrometer Spindle

3) Record the depth measurement in the "NCLS.xls" spreadsheet file in the 'Restricted Lab' sub-directory (folder). (Actual Depth Column)

4) Measure the width and thickness of the center section of the sample with a micrometer. Record these measurements in the "NCLS.xls" spreadsheet file in the 'Restricted Lab' sub-directory (folder). (Thickness & Width Columns)

5) The calculated depth of the cut is indicated on the "NCLS.xls" spreadsheet. The tolerance is +/- 0.001 inches. If the depth is outside of this tolerance, adjust the depth of the cut during the cutting process on the Instron (see step 5.B.19). (Ex. To make a shallower cut, stop the cutting process before –0.0130. To make a deeper cut, stop the cutting process after –0.0130.)

6) Repeat instructions 5B through 5C until the instructed amount of samples is obtained. (The instructed amount ranges from 5 to 40 samples.)

E) Preparing Weight Tubes According to The Applied Force Required For Each Testing Sample.

1) Fill the weight tube with lead shot or remove lead shot from the weight tube until the total weight of the weight tube equals the specified amount indicated in the "Applied Force" column on the "NCLS.xls" spreadsheet. The numbers on the weight tubes correspond with the numbers on the "NCLS.xls" spreadsheet. Use a shadowgraph to measure the weight of the weight tubes.

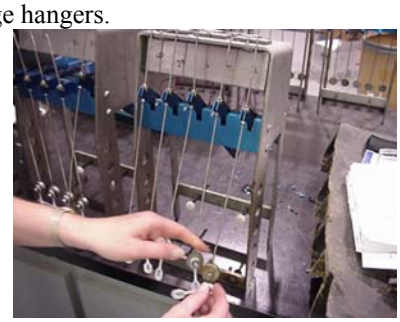
Lead Shot

Adjust Weight

Weigh on Shadowgraph Scale.

F) Testing Samples in The NCLS Machine

1) Attach samples to the 'lollypop' assembly on the NCLS module assembly corresponding with the sample number shown on the carriage hangers.



2) Place the NCLS module assemblies in the tank. The agitator should be turned on.

Let the test specimens sit in the bath for approximately 30 minutes before adding the test tubes.

3) After the 30 minutes, attach weights to the 'lollypop' assemblies. Immediately reset (zero-out) the timers after each weight is attached to a 'lollypop' assembly.

4) Once all of the NCLS module assemblies have been added to the NCLS machine, cover the machine with the acrylic plastic cover.

5) In time, the IGEPAL solution will weaken the samples and cause them to break. Once the samples break, the timers will stop. Record the time that it took for each sample to fail in the corresponding blanks in the "NCLS.xls" spreadsheet.

Weight drops after sample breaks.

6.0 RELATED DOCUMENTATION

1) "NCLS.xls" Spreadsheet (Lab Restricted sub-directory (folder))
2) NCLS Machine Manual
3) Compression Molding of Tensile, Flex, & Izod Specimens, LAB-WI-03.

7.0 CHANGE HISTORY

This document was originally issued on October 27, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
7/23/01	Changed document number from CL-05 to LAB-WI-05	1
9-9-02	Added information about 30 minutes "presoak" on test samples.	2
10-24-04	Removed references to NCTL where needed and replaced with NCLS	3

1.0 PURPOSE/SCOPE

To provide detailed instructions on the procedure for determining the % stretch or elongation of a sample of pipe sizes 3" thru 10". This procedure will also describe the Joint Integrity Procedure for the pipe.

2.0 RESPONSIBILITY

The lab technician responsible for testing each pipe sample following this procedure. The technician has the authority to determine the disposition of the pipe based on the test results.

3.0 SAFETY

The lab technician is responsible for following all Hancor Safety Guidelines and specific safety requirements called out in this procedure.

4.0 EQUIPMENT

Tape measure, stopwatch, room with hook from ceiling with enough area to hang 50" of pipe, round clamps and weights, china marker and cutting knife.

5.0 PROCEDURE FOR ELONGATION

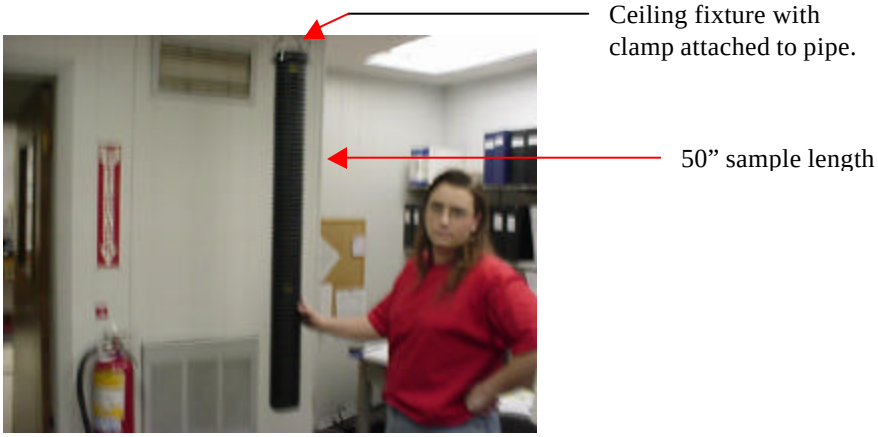
5.1 Select the pipe to be checked for elongation, which is usually 1 – 5' section from each blend that each plant produces, take the samples into the temperature-controlled room.

5.2 Allow sample to condition for at least 24-hours.

5.3 Using the tape measure and cutting knife, cut the sample into a 50" length.

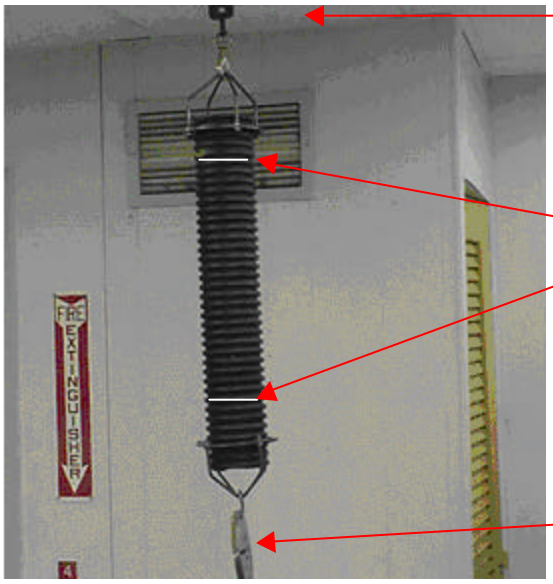
5.4 Using the round clamps designated for that size of pipe, clamp one end of the sample at least 2-3 corrugations back from the end and hang it from the hook that is fixed to the ceiling. **See picture #1 below**

Picture # 1



5.5 Place another round clamp on the other end of the pipe, once again at least 2-3 corrugations back. **See Picture 2 – next page**

Picture 2



5.6 Find the tare weight for the diameter of pipe that you are testing. The tare weight is one times the diameter. (Example for 4" pipe the tare weight is 4 lbs., for 6" pipe the tare weight is 6 lbs, etc)

5.7 Hang the tare weight from the bottom round clamp and let it rest to insure the pipe is in straight position.

5.8 Start near the top of the sample and mark a starting point in which to measure from using the china marker. Use the tape measure and measure down 30" (when testing pipe that is 3"-6" in diameter) if you are testing 8" the measurement needs to be 36". Mark the end of the 30" with the china marker once again.

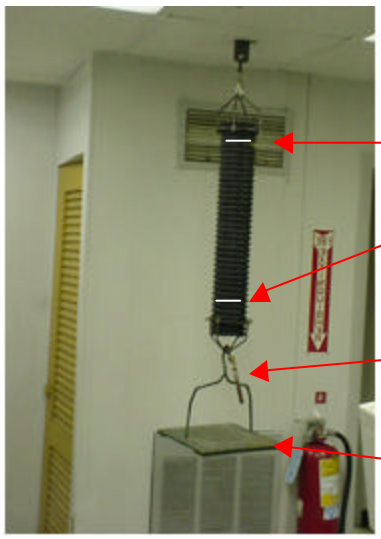
5.9 You are now ready to start the actual test. Find the test weight for that diameter of pipe. The actual test weight is five times the diameter that you are testing. (Example for 4" pipe, the test weight is 20 lbs., for 6" pipe the test weight is 30 lbs.)

5.10 Keeping the tare weight attached, add the test weight to the bottom round clamp and start the stopwatch. (Total weight = tare plus test weight) **See Picture 3 next page**

5.11 The test will run for 3 minutes. Try not to move the pipe during the test.

5.12 After the 3 minutes, re-measure the 30" that you had marked off in step 5.7, keeping the weights attached while you measure.

Picture 3



5.13 Determine the % of elongation by using following formula: Inches stretched divided by 30 times 100. (Example the pipe stretched 1-1/2 inches: 1.5 divided by 30 =. 05 x 100=5.0% elongation)
(Example for 8" pipe is: 1-1/2 inches: 1.5 divided by 36 =. 04 x 100=4.16% elongation)
The % Elongation of any pipe must be 10% or less. If any pipe stretches over 10%, notify the branch and have them re-submit pipe made with the same blend of material and made on the same date as the original sample.

5.14 Remove the weights and clamps and repeat the above procedure for each sample.

5.15 Record results on form LAB-F-5 along with the Date Code, Blend # and diameter. This form is located in the Pipe Elongation Book.

6.0 PROCEDURE FOR JOINT INTEGRITY

All of the above steps will be repeated, however this time there will be a coupler attached to the bottom clamp on the hanging pipe. After the test is complete, inspect the pipe and coupler for separation.

7.0 NON-CONFORMING RESPONSE

When any pipe stretches over 10% the plant will be notified and pipe may be re-submitted for testing providing it was made with the same raw material and was produced on the same date. If the resubmitted sample stretches over 10% again, then the pipe must me ground up.

8.0 RELATED DOCUMENTATION

AASHTO M252 (External Document)
BNQ 3624-110 (External Document)
BNQ 3624-115 (External Document)

9.0 CHANGE HISTORY

This document was originally issued on Nov. 1, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
7/23/01	Changed document number from CL-07 to LAB-WI-07	1
7/24/01	Changed Form number from Form ST-5 to LAB-F-5	2
01-03-02	Added Canadian test methods	3

Hancor® Work Instruction		LAB-WI-10 Page 1 of 5
Title: Melt Index		Revision Date:7/23/01 Revision Level: 1
Issued by: Quality Team	Approved by: D. Gonso	Date: 10/9/00

1.0 PURPOSE/SCOPE

The purpose of this instruction is to determine the flow rate of polyethylene.

2.0 EQUIPMENT DESCRIPTION

Mettler Balance, Melt Index Machine, 2060-gram weight, 25-lb. weight, funnel, loading rod, spatula, forceps, 100 gram piston, cleaning rod, cotton gun patches, stopwatch, and vile.

3.0 RESPONSIBILITY

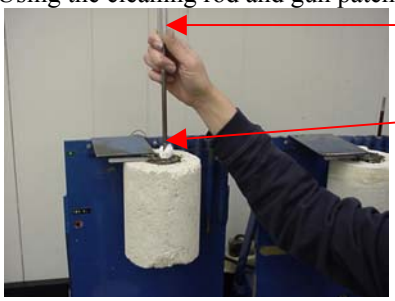
The lab technician is responsible for testing material in accordance with this procedure. The lab technician has the authority to determine disposition of material based on the tests/results.

4.0 SAFETY

The lab technician is responsible for following all Hancor Safety Guidelines and specific safety requirements called out in this test procedure.

5.0 PROCEDURE

5.1 Using the cleaning rod and gun patches, clean the barrel of each melt index machine.



5.2 Check the temperature (190 degrees +/- 0.2 degrees Celsius) of each melt index machine and level prior to using.

Check temperature.

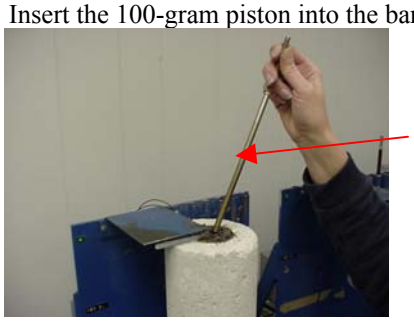
5.3 Zero the Mettler balance and level using the built-in level on top of the machine along with the adjusting feet.

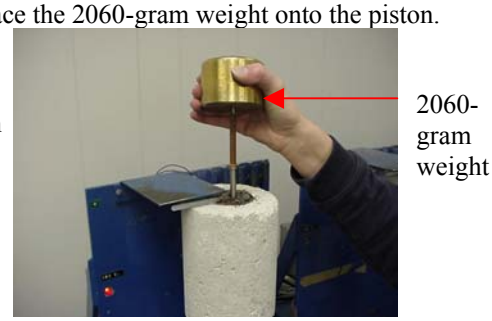
5.4 Set the clear vile on the Mettler balance and weigh up three grams of material to be tested.

5.5 Using the funnel, pour three grams of material into the top of the melt index machine.

5.6 When testing re-grinds of larger particles, use the loading rod to help cram the material in the barrel.

5.7 Insert the 100-gram piston into the barrel and place the 2060-gram weight onto the piston.



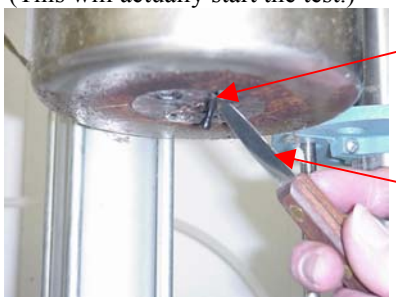


5.8 Compact the material in the barrel by slowly pushing down on the weight to release any trapped air.

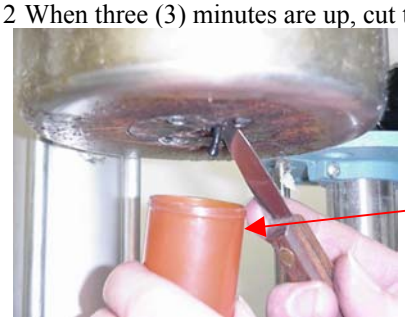
5.9 Start the stopwatch and ‘pre-melt” the material for six (6) minutes.

5.10 After the six (6) minutes are up, push down on the weight once again to ensure proper flow.

5.11 Using the spatula, cut the extradate and at the same time, re-start the stopwatch for three (3) minutes. (This will actually start the test.)



5.12 When three (3) minutes are up, cut the extrudate once again, this time catching it in the vile.



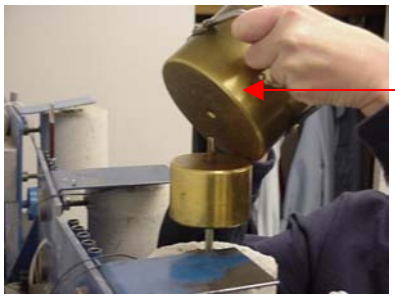
5.13 Using the Mettler Balance, weigh the extrudate to the nearest thousandth (0.001) of a gram.

5.14 Use the following calculation to figure melt index:

$$\text{MI (Melt Index)} = \frac{10 \text{ minutes}}{3 \text{ minutes X weight of extrudate}}$$

5.15 Record the results along with the Purchase Order number and individual box or compartment number in the Melt Index Notebook, which is located near the Mettler Balance. The results must then be transferred to LAB-F-2

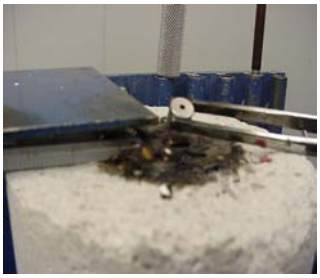
5.16 Place the 25-lb. weight on top of the 2060-gram weight to help purge the unused material out of the barrel.



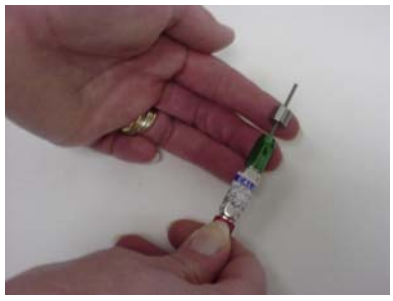
25 lb. weight

5.17 Remove the two weights and clean the barrel with clean cotton gun patches as specified in step 1.

5.18 At the end of each week, the Lab Technician will remove the orifice from each melt index machine by prying up through the bottom of the barrel with a short rod. The barrel will be very hot **do not touch the orifice with your bare hands,** use a pair of tweezers. Clean the orifice using the .0815" drill bit and a razor blade.



Let the orifice set out over the weekend. On the next business day the technician will verify the orifice hole size using the go/no go gage.



6.0 RELATED DOCUMENTATION

6.1 ASTM D 1238, "Flow Rates of Thermoplastics by Extrusion Plastometer"
6.2 LAB-F-2, Raw Material Test Sheet

7.0 CHANGE HISTORY

This document was originally issued on October 9, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
7/23/01	Changed document number from CL-10 to LAB-WI-10	1

1.0 PURPOSE/SCOPE

The purpose of this instruction is to check the resistance of P.E. raw materials to the effects of chemicals found in the environment.

2.0 EQUIPMENT DESCRIPTION

Carver Press, Chases, Mylar, ESCR test bath, Vice, Band saw, Izod Bar Template, ESCR Bar Template, & milling machine.

3.0 RESPONSIBILITY

The lab technician is responsible for testing material in accordance with this procedure. The lab technician has the authority to determine disposition of material based on the tests/results.

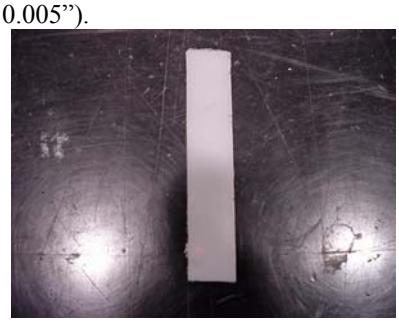
4.0 SAFETY

The lab technician is responsible for following all Hancor Safety Guidelines and specific safety requirements called out in this test procedure.

5.0 PROCEDURE

5.1 Prepare a raw material test sheet using the "tensile bar" chase (5" x 5" x 0.075"). Test specimens should be prepared in accordance with procedure LAB-WI-03, Flex/Izod/Tensile Bar Preparation.

5.2 Once the test sheet is done , use the plastic Izod test bar and draw the bars on the sheet. 10 good bars are required per test. Cut the bars out of the sheet using the band saw. Use a micrometer to verify the thickness of the test sheet (0.075" ± 0.005").



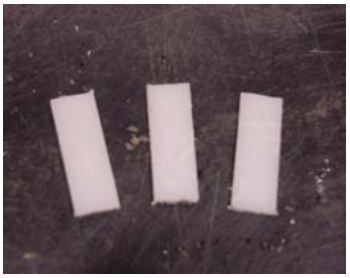
5.3 Place the "cut-out" bars in the Izod bar template and use the milling machine and mill each side of bar so it ends up 1/2" wide. Use a micrometer to verify the width of the bars.

Place bar in the template.

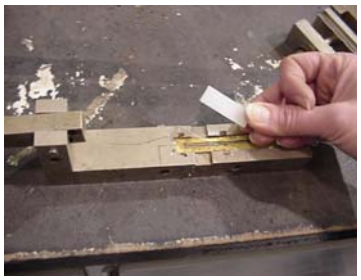
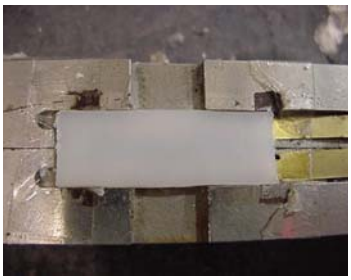
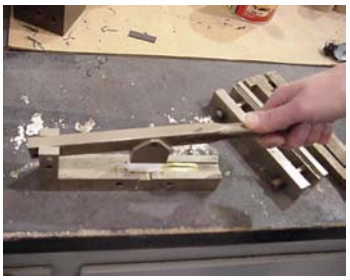
Mill each side of the bar

Measure with a micrometer (1/2").

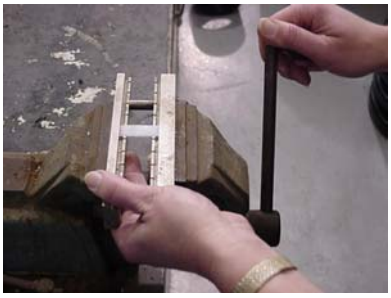
5.4 Cut each milled bar to 1.5" ± 0.1" in length by using a straight edge and band saw.

5.5 Place each bar individually in to the ESCR blade notcher and put a notch in the bar. Adjust the razor so the notch depth is 0.012" to 0.015" deep. Use metal shims if necessary.

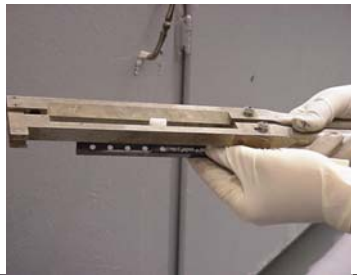
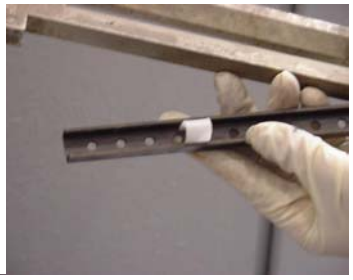




5.6 Once all 10 bars are notched, place the bars in the ESCR bar-bending fixture with the notched side facing you.


5.7 Place the ESCR bar bending fixture in to the vice and close the vice to the point where the ESCR bar bending fixture can no longer close.

5.8 Transfer the bent test bars to the clamp holder and then to the ESCR test holder. There should be ten (10) specimens per holder. Seven (7) specimens will be acceptable if notching creates a lot of rejects.

5.9 Place ESCR test holder in the ESCR Bath tubes and place Rubber stopper in the top of the Tube. Place tube back into the ESCR Bath.


5.10 Verify that the temperature of the ESCR bath is 50 $\pm$ 0.5 ^{o} C. If temperature is not correct, make the appropriate adjustment and wait until the temperature reaches the correct range and stabilizes. Contact the Lab Supervisor for help. Also, verify that there is sufficient IGEPAL CO-630 to cover the test specimens completely. Add IGEPAL to test tubes only.

5.11 After the samples are placed in the ESCR bath, periodically check to make sure samples are still in their holder. You may have to start the test over if more than 2 samples fall out.

5.12 Once the samples are in the ESCR bath, start timing for a period of 24 hrs. At the end of this time period, take the samples out and inspect for any stress cracking around where the notched was located. You may have to wipe the IGEPAL off the sample to get a better view.

5.13 The material is considered unacceptable if more than 50% (5 of 10) of the test specimens crack.
5.14 Refer to ASTM D-1693 to interpret the results of the test.

6.0 RELATED DOCUMENTATION

6.1 ASTM D 1693 -- "Standard Test Method for
6.2 Environmental Stress- Cracking of Ethylene Plastics"
6.3 LAB-WI-03 - Flex/Izod/ Tensile Bar Preparation

7.0 CHANGE HISTORY

This document was originally issued on October 17, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
7/23/01	Changed document number from CL-12 to LAB-WI-12	1
1-27-03	Removed Microscope Photo	2

1.0 PURPOSE / SCOPE

To provide detailed instructions on the correct manner in which to perform the Density Test using a gradient column on virgin polyethylene. This procedure will also explain in detail the correct procedure for mixing the solution and filling the columns that are used in this test.

2.0 RESPONSIBILITY

Each lab technician is responsible for seeing that this test procedure is followed during the mixing of the solution, filling of the columns and the actual testing of the raw material.

3.0 EQUIPMENT

Hot plate, 2-70 Cm glass columns, 2-Techne TE-10A heaters, 1000 ml. Glass cylinders, 2-large flasks, 2-large beakers, glassware attachments, magnetic stirring bar, "known" density glass floats. Propanol 2, distilled water, shadowgraph scale.

4.0 SAFETY

Observe all Hancor Safety rules. Propanol 2 is highly flammable. Do not smoke or have an open flame near it. Also, store unused Propanol in a fire/explosion proof container or cabinet.

5.0 PROCEDURE

FOR PREPARING THE MIXTURE FOR FILLING THE DENSITY COLUMN:

- Decide on the range of density that you want to measure in the gradient columns.
- Locate the Density Column Prep file on the H: drive.
- Type in the min and max range of density that the column will contain.
- Use this worksheet when you prepare the solution for the column.
    1. Preheat the hot plate for 15 minutes
    2. Using the Density Column Prep sheet, start by mixing the light mixture, using a large glass 1000 ml cylinder.
    3. Use one cylinder for the distilled water and one for the propanol-2.
    4. After you have the proper amount of each liquid in the cylinders, begin mixing the solution by pouring them back and forth into each cylinder approximately 10 times.
    5. Pour the mixed solution into a large beaker that is marked "Light".
    6. Cover the top of the beaker with foil or a cork.
    7. Heat the solution on the preheated hot plate for 10 minutes.
    8. After the 10 minutes, remove the beaker from the hot plate and allow the mixture to reach room temp. This solution may sit over night or a minimum of 2 hours.
    9. Repeat the above steps to mix the "Heavy" solution

6.0 PROCEDURE

For filling the density column:

- Set up the glassware as shown in fig 1 in the photos below.
- Be sure all stopcocks are closed. Keep the column heater on during filling process.
- Pour the "light" solution into the beaker that is closest to the column being filled.
- Make sure that the magnetic stirring bar is in the bottom of this beaker.
- Fill this beaker with the light solution to about 1-1/4 " from the top.
- Fill the back beaker with the "heavy" solution to about 1/4"" from the top. (heavy pushes light)
- Replace the corks or foil on both of these beakers during the filling process.
- Slowly open Stopcock (part # 2021) that connects the two beakers.

- Once the two columns have reached "equilibrium," slowly open valve (part # 2022) at filling tube
- Begin filling the column at a rate of approximately 1 cm per minute, making sure to adjust if you see a lot of bubbles going into the filling tube.
- Do not change the rate of filling once the solution has reached the first set of numbers at the bottom of the column.
- When the column is filled approximately ¾" from the top, turn the valve (part # 2022) off.
- Unplug the stirring bar mechanism
- Slowly remove the filling tube.
- Place a black rubber lid or cover on the column.
- Let the column sit for about 1 hour, make sure the column is at the proper temperature of 23^0 C, (+/-.1) then drop the "known" density floats into the solution.
- After the density floats have maintained their stopping point, you are now ready to plot the densities for this column. Use the Density Gradient Graph worksheet located in the Lab Restricted File on the "H" drive on the computer.

7.0 PROCEDURE

For Raw Material Testing using the Density Gradient Column

- Verify the proper temperature 23^0 C, (+/-.1)
- Check to see that all of the floats are in the right location, this is like a calibration.
- Cut a small sample of the material that is to be tested. (About a ½" cube)
- Dip the cube into a small amount of propanol-2 to remove any oils or debris.
- Allow the sample to air dry prior to testing.
- After the sample is dry, drop the cube into the column using tweezers.
- Follow the sample as it travels down the column. Each line on the column represents a different density range.
- As the sample begins to slow, use the density conversion graph found on the H: drive and reference the exact density where the sample stopped.
- Repeat the above steps for each compartment that is to be tested.
- Compare the results with the COA received from the vendor to confirm the density.

6.0 NON-CONFORMING RESPONSE

If at any time during testing, the density does not compare to the COA results a retest must be preformed on the material.

If after the retest, the sample is still non-conforming then contact the Buyer about the disposition of the material.

7.0 RELATED DOCUMENTATION

- Density Column Prep file on the H: drive
- Density Gradient Graph worksheet located in the Lab Restricted File on the "H" drive on the computer.
- RM-WI-06 Raw Material Rejection Procedure

8.0 CHANGE HISTORY

This document was originally issued on May 9, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL

Hancor®		VM - 1
		Page 1 of 2
TITLE: Determination of Weight Per Foot [lbs./ ft.]		Revision Date: 5/25/05 Revision Level: 3
Issued by: Jo Dible	Approved by: Dave Gonso	Date: 9/11/00

1.0 PURPOSE/SCOPE

To clearly define the methods used in determination of weight per foot of pipe products. These methods apply to all pipe products (dual-wall, single wall, and smoothwall). Running pipe out of specification can cause PII/Yield problems and possible field failure problems.

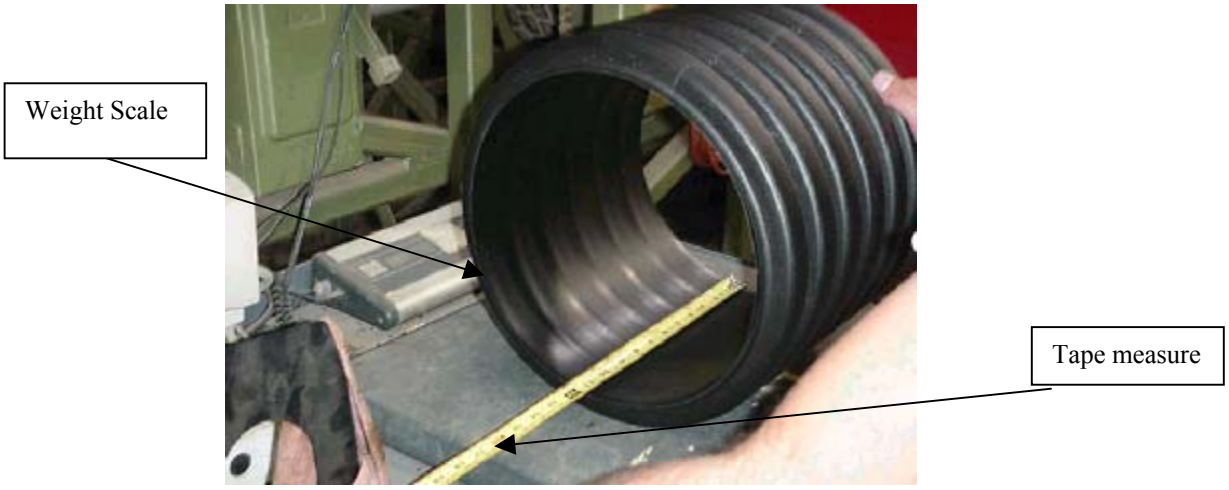
2.0 RESPONSIBILITY

The operator will check per frequency established on the product control plan.

3.0 SAFETY

Practice care when cutting pipe sample. This is an area of potential injury. Follow Hancor Safety Policy.

4.0 PROCEDURE



4.1 METHOD 1 [1st Piece Verification sample]

A. Cut a 1-foot sample off a roll or a stick of pipe (including smoothwall). Use the sample for PII testing when possible. You may want to make short sticks on the Inline process to get your sample. This will keep the scrap rate down.
B. Remove water from the sample by shaking, wiping, or drying.
C. Place the sample on scales and record weight.
D. In the case where the sample is NOT exactly twelve inches (12”), the following formula must be used: [scale weight] ÷ [sample length] x [12] = lbs./ft.
E. Record the weight per foot result on 1st piece verification record and SPC chart.

4.2 METHOD 2 [Entire "unit" of pipe and utilization of floor scales or in-line scales] {QC weight}

A. Place the entire piece of pipe to be measured on the scale.
B. Remove excess water from the pipe to be weighed.
C. Measure the entire length of the pipe including coupler/top hat (if applicable).
D. If the pipe contains an in-line coupler, assure that the "top hat" is placed on the scale along with the pipe or add the weight of the "top hat"(from a table scale) to the weight of the pipe. If the gasket is on the pipe, weigh a gasket of the same size and subtract its weight from the pipe.
E. Use the following formula to calculate lbs./ft.:
Lbs./ft. [scale weight] ÷ [sample length] x [12] Example 350 lbs = sample stick wt.
257" = sample stick length
350 / 257" x 12 =16.34 Wt./ Ft.
F. Record the weight per foot result on 1st piece verification record and SPC charts.

5.0 RELATED DOCUMENTATION

1. Verification Forms

PROCESS	1st Piece Verification Record	SPC Chart
3660	3660- F- 12	√
3020	3020-F-1	√
UC-250	UC 250-F-3	√
260-44	260-44-F-1	√
SMOOTH-WALL	SW-F-4	√
2" LINE	2-F-9	√

6.0 OUT OF CONTROL

If product is out of specification, refer to Product Control Plan. If product is out of control refer to S.P.C. chart.

7.0 CHANGE HISTORY

This document was originally issued on September 11, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
12-18-00	TEXT	1
4-13-01	Removed reference to JD Edwards	2
5-25-05	Adding weighing the "top hat" and gasket on a separate scale.	3

Hancor®	VM - 13	
	Page 1 of 2	
TITLE: Measure Pipe Length.	Revision Date: 9-22-03 Revision Level: 2	
Issued by: Jo Dible	Approved by: Dave Gonso	Date: 9-11-00

1.0 PURPOSE/SCOPE

To ensure that all plants and plant personnel measure the length of the product in the same manner and method. This procedure will prevent too long or too short of product from getting to our customers. All pipe production at all production sites will follow this procedure for all products.

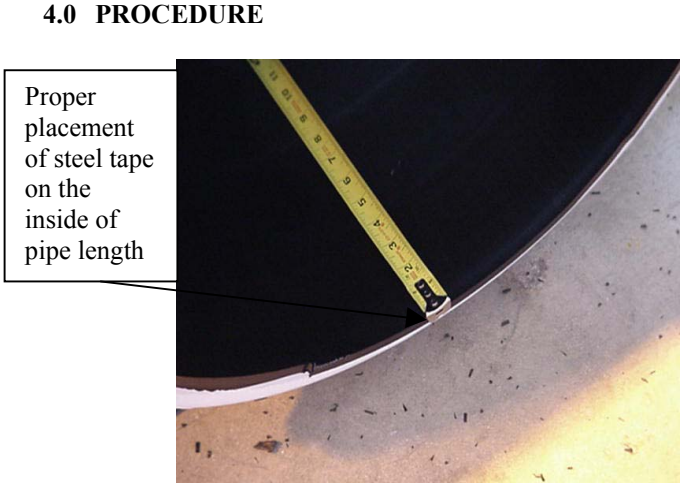
2.0 RESPONSIBILITY

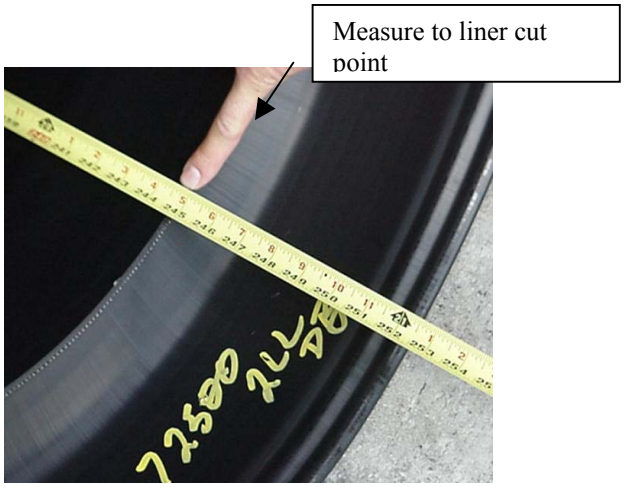
The operator will check per frequency established on the Product Control Plan.

3.0 SAFETY

Always follow Hancor safety procedures. Note that measuring pipe on the plant floor creates a trip hazard.

4.0 PROCEDURE





4.1 The operator will measure the length of the product per the frequency chart established for each product control plan. (e.g. 3020, 260-44, 3660, UC250, 2",and Smoothwall).

4.2 For product lengths up to 30 feet.

A. 3020, 3660. UC250 and Smoothwall :(Smooth Interior)
With a tape measure accurate to 1/16 of an inch, measure the length of the pipe through the inside and record the results on the first piece verification record for the process you are running. To verify the 99% min requirement, take your actual measurement and multiply by .99. If the W.O. calls for 20 foots stick multiply 20' by .99 and compare the two results. The actual measurement should be equal to or greater than the W.O. result.

B. For corrugated interior, place the tape measure on inside of pipe and measure from the very end to the opposite end of pipe.

C. 260-44, 2" line
Use a surveyor's wheel to measure the length of the pipe coil greater than 30 feet.

5.0 RELATED DOCUMENTATION

1. Verification Forms

PROCESS	1st Piece Verification Record	SPC Chart
3660	3660- F- 12	
3020	3020- F- 1	
UC-250	UC 250-F-3	
260-44	260-44-F-1	
SMOOTH-WALL	SW-F-4	
2" LINE	2-F-9	

2. Standards:
   AASHTO M252 (External Document)
   AASHTO M294 (External Document)
   ASTM F-810 (External Document)

6.0 OUT OF CONTROL

If pipe length is out of specification, check the Product Control Plan for instructions.

7.0 CHANGE HISTORY

This document was originally issued on September 11, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
12-18-2000	Text	1
9/22/03	Changed AASHTO MP7-97 to AASHTO M294	2

Hancor®	VM: 19	
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TITLE: Determination of Pipe PII (Pipe Stiffness)	Revision Date: 12-1-04 Revision Level: 10	
Issued by: Jo Dible	Approved by: Dave Gonso	Date: 9-11-00

1.0 PURPOSE/SCOPE

To provide a standard test method using the LO-TES PII test machine to insure a standard method for each plant assuring accurate and repeatable results. This method is for LO-TES Model 10 fully automated computer integrated, menu driven tester. Refer to LO-TES or Plowman Brothers Industries Operating manuals. Diameters 8" – 60" can be run on this machine.

2.0 RESPONSIBILITY

The operator will check per frequency established on the product control plan.

3.0 SAFETY

Practice care when cutting pipe samples. This is an area of potential injury. See LO-TES Operating manual for other safety guidelines. Follow Hancor safety policy.

4.0 PROCEDURE

4.1 Condition samples in a temperature controlled room, which maintains a temperature of 70 to 77 F. When certifying for CSA, or BNQ agencies, samples must be conditioned for 40 hours. When certifying for D.O.T, AASHTO samples must be conditioned for 24 hours.

4.2 For sample test frequency – refer to specific product control plan.

4.3 For D.O.T., CSA, and BNQ certification, after stock lot is completed, take 4 random samples representing the lot to be certified. Note: 1 of the 4 samples will be used in the pipe compression strength test for CSA certification. For BNQ and AASHTO certification only 3 samples are needed.

Turn on machine and let it warm up a minimum of 5 minutes

4.4 Calibrate the machine as described in the LO-TES Manual

4.5 Press F2 key on keyboard (menu of selected pipe diameter)

4.6 Make the selection of pipe diameter you are testing. Press the number designating the pipe diameter. A new menu will appear.
4.7 Make selection of pipe size and the sample information menu will appear.
4.8 Press F10 key to modify sample information (sample O.D., I.D. date code, length)
4.9 Use the cursor key to select O.D. and then type in actual value. Repeat for I.D.
4.10 For O.D. – measure across from seams and 90 degrees to the seams. Enter the larger of the two. Use VM # 4
4.11 For I.D. – measure across the seams and 90 degrees and average the two measurements. Enter the average into the computer. Use VM # 3
4.12 For length – measure the actual length of the sample. Enter this data into computer. Use table 1 & 2 to verify sample information needed. All pipe sizes (**except 3"-10**") should include the following deflection points (5%, 10%, 20%, **40%)** and a travel rate of 0.5" per min.

Table 1
Pipe diameter minimum sample length

10"…….see VM 22			
12"……..12"	"	"
15"……..15"	"	"
18"…… 18"	"	"
24"……..24"	"	"
30"……..30"	"	"
36"……..36"	"	"
42"……..42"	"	"
48"……..48"	"	"
54"……..54"	"	"
60"……..60"	"	"

Table 2
Set-up and sample information

Pipe Dia.	Pre-load	Max. pressure (lbs).
8"…….. see VM 22		
10"…… see VM 22		
12"…….10…….1300		
15"…….10…….1600		
18"…….20…….2000		
24"…….25…….4100		
30"……..35…….5500		
36"……..40…….6500		
42"……..50…….7000		
48" …….60…….9500		
54"	60	9500
60"	60	9500

4.13 Press F9 to start to start the test
4.14 Press F8 to type in comments – blend#, Date code, WT/FT., Material specs.
4.15 After comments are typed in press F9 key. The carriage (Top Plate) will go down to the proper position for the diameter selected.
4.16 The Pipe diameter and dimensions will appear on screen
4.17 You are ready to teat your pipe specimen.
4.18 Position your pipe sample in the center of test machine
4.19 Position specimen so the seams are 90 degrees from Plates
4.20 For D.O.T certification, test 3 specimens with seams 90 degrees, 45 degrees and 180 degrees from plates. 
4.21 For BNQ and CSA certification, test 3 specimens with one sample with the thinnest cross sectional area 90 degrees to the plates, second sample with thin spot rotated 35 degrees from the plate surface and the last sample with the thin spot rotated 70 degrees from the plate surface. 

4.22 For QC tests (first piece) let the samples condition in the temperature control room for a minimum of 4 hrs. Using an ultrasonic thickness gage (for dualwall products) find the thinnest point on the crown (do a die center of 8 readings for diameters 10-30 and 16 readings for 36 – 60). Use the thin spot as the orientation to test instead of the seams.

4.23 Press the enter key. Make sure the plates are moving together and the sample does not roll out of proper position.

4.24 After the test is complete, repeat the above steps for the next specimen.

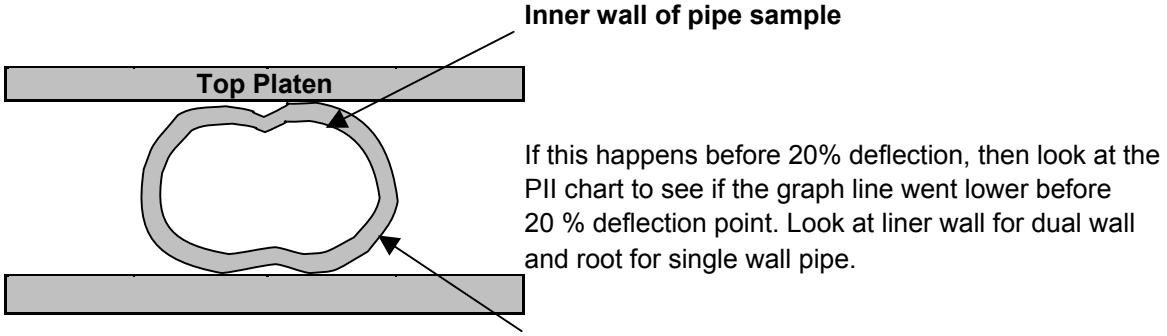
This next section describes how to determine whether a sample passes the 5% or 20 % requirements.

4.25 As each test is completed, verify that the 5% PII value meets the requirement (AASHTO or BNQ). The minimum requirement is found on the CONTROL PLAN. If the sample does not meet the minimum requirement follow the instructions on the CONTROL PLAN.

4.26 **For AASHTO and ECO 12"-60" pipe** the 20 % Flattening specification will be interpreted as follows: the load curve on the PII chart must not fall before the 20% deflection point has been reached. See CONTROL PLAN if the curve goes down (rejected). Also, the pipe sample needs to be visually inspected for any cracking, delamination and splitting of the pipe walls, liner weld, and block seam area. Again if any of these conditions are present and occur at or before the 20% point is reached then the product is defective.

4.27 **For NON-AASHTO pipe (Heavy Duty)** the 20 % Flattening specification will be interpreted as follows: the test operator needs to be present and visually inspect the sample while being deflected at the 20% point. The operator will look for reverse curvature of the liner (HI-Q type product or root wall of single wall type product). See diagram 1 below. If this occurs and the curve on the chart also goes down before the 20% point is reach then the sample fails. Both (reverse curvature and graph curve down) have to occur for failure. Also, the pipe sample needs to be visually inspected for any cracking, delamination and splitting of the pipe walls, liner weld, and block seam area. Again if any of these conditions are present and occur at or before the 20% point is reached then the product is defective.

Diagram 1



Outer wall of pipe sample

4.28 When all tests are complete and machine will not be used for a long time (i.e. weekend or holiday), press the F5 key followed by the "Y" key to completely shut down the machine.

5.0 RELATED DOCUMENTATION

1. Product Control Plans (Internal Document)
2. LO-TES operating manual (External Document)
3. ASTM D-2412 parallel plate test (External Document)
4. VM # 3 (I.D.) (Internal Document)
5. VM # 4 (O.D.) (Internal Document)
6. AASHTO M294 (External Document)
7. AASHTO M252 (External Document)
8. BNQ 3624-110 (External Document)
9. BNQ 3624-115 (External Document)
10. BNQ 3624-120 (External Document)
11. CSA 182.6 (External Document)

1. VERIFICATION FORMS

PROCESS	1st Piece Verification Record	Control Chart
3660	3660- F- 12	
3020	3020- F- 1	

6.0 OUT OF CONTROL

Refer to the Product Control Plans for instructions. Also see GEN

7.0 CHANGE HISTORY

This document was originally issued on September 11, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REV. LEVEL
12-18-00	TEXT	1
01-03-02	Added Canadian Test Requirements	2
4-12-02	Added section on interpreting 5% & 20% specification requirements and interpretations. See step 4.24 – 4.26. Added diagram 1	3
8-1-02	See step 4.22 added thin spot orientation for QC testing	4
8-21-02	Changed conditioning time for AASHTO from 40hrs. To 24hrs.	5
12-18-02	Added 30% deflection requirement	6
9/22/03	Changed AASHTO MP7-00 to AASHTO M294	7
4-19-04	Step 4.26 added ECO 12"-60" in this specification requirement	8
9-28-04	Step 4.12 was changed to add 40% flattening.	9
12-1-04	In tables 1 and 2 reference to use VM 22 for 8 and 10 inch pipe	10

1.0 PURPOSE/SCOPE

To prevent and identify cracking problems in **coiled** corrugated pipe before our customers receive the product. This is a QA. Test based on the requirement outlined in AASHTO M-252 sect. 9.6 and BNQ 3624-115 and 110 6.2.3. This method allows for a reduction in conditioning time so that the quality of product identified through this test is determined. Once per year all diameters will be tested according to AASHTO M-252 while testing shall be conducted per frequency established on the product control plan for BNQ certification, when testing per AASHTO or BNQ specification, the Central Lab and any other production facility with the equipment necessary will test per protocol .

2.0 RESPONSIBILITY

The operator will check per frequency established on the product control plan.

3.0 SAFETY

Practice care when cutting pipe sample. Follow Hancor Safety Policy.

PROCEDURE

4.1 The operator will cut three pipe samples to length as specificed in the table below; and test per the product specification and control plan.

Table 1. Minimum sample length and conditioning times used for test samples. FOR COILED pipe only

Pipe Dia.	AASHTO sample length	AASHTO QA/QC Conditioning Time in freezer are min. times Temp is 21 – 28 ° F	BNQ sample length	BNQ QA/QC Conditioning Time in freezer are min. times Temp is 30 – 34 ° F (1)
2”	60” min	For QC - 1 hr	30” min	N/A
3”	60” min	For QA- 24 hrs For QC – 1 hr	45” min	For QA- 24 hrs For QC – 1 hr
4”	60” min	For QA- 24 hrs For QC – 1 hr	60” min	For QA- 24 hrs For QC – 1 hr
5”	60” min	For QA- 24 hrs For QC – 1 hr	75” min	For QA- 24 hrs For QC – 1 hr
6”	60” min	For QA- 24 hrs For QC – 1 hr	90” min	For QA- 24 hrs For QC – 1 hr
8”	60” min	For QA- 24 hrs For QC – 1 hr	120” min	For QA- 24 hrs For QC – 1 hr
10”	60” min	For QA- 24 hrs For QC – 1 hr	150” min	For QA- 24 hrs For QC – 1 hr
12”		N/A	180” min.	For QA- 24 hrs For QC – 1 hr

1. For BNQ temperatures you can use the AASHTO temp since these are more severe. Or you can invest in another freezer (make sure it is large enough to be able to accept the entire sample size).

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4.2 For pipe diameters of 2”, 3”, 4”, 5”, 6”, 8” , 10” and 12” bend the sample in a U shape pattern and secure ends together. Use twine to tie them together.

4.3 For AASHTO and BNQ do the following:

a) Place samples in freezer for the appropriate time periods - 1 hr for QC and 24 hrs for QA.

4.4 After proper conditioning time remove sample (AASHTO only) and bend pipe back in opposite direction over a 15" Mandrel for sizes 2" thru 8" diameters and over a 20" Mandrel for 10" diameter pipe. Bend.pipe within 30 seconds of removal from freezer.
Look for any cracking or splitting. If cracking or splitting occurs notify management. Quarantine pipe and re-sample.

4.5 For BNQ pipe remove samples and reverse bend the pipe to the point when the ends touch again. Bend.pipe within 30 seconds of removal from freezer. Look for any cracking or splitting. If cracking or splitting occurs notify management. Quarantine pipe and re-sample

4.6 Record pass or fail on 1st. piece verification record.

5.0 RELATED DOCUMENTATION

1. Verification Forms

PROCESS	1st Piece Verification Record	SPC Chart
260-44	260-44-F-1	
2" LINE	2-F-9	

2. Standards:
   AASHTO M252 (External Document)
   BNQ 3624-110 (External Document)
   BNQ 3624-115 (External Document)

6.0 OUT OF CONTROL

Refer to Product Control Plan for instructions.

7.0 CHANGE HISTORY

This document was originally issued on September 11, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
12-18-00	TEXT	1
5-29-01	Sample Length Increase	2
1-3-02	Added Canadian test requirements	3
10-31-02	Added to title Low Temperature Flexibility . Added Mandrel requirement in 4.4	4
12-21-04	Added information to table 1 concerning freezer temp. and conditioning times.	5

1.0 PURPOSE/SCOPE

The operator will check per frequency established on the product control plan. The installation design specifications make the inside diameter critical in determining flow characteristics of the pipe.

2.0 RESPONSIBILITY

The operator will check per frequency established on the product control plan and fill out the first piece form completely..

3.0 SAFETY

Practice care when cutting and measuring pipe samples. Follow Hancor Safety Policy.

4.0 PROCEDURE

4.1 Tape measure or Caliper [method 1]

Method 1-Using a tape measure to check the inside diameter of pipe

Method 1-Using a caliper to check the inside diameter of pipe

A. For ASTM F405 and F667 pipe (4"-24" Heavy Duty) measure inside diameter from seam to seam then measure at 90 degrees from the seams. Add both measurements together and divide by 2 to obtain the average inside diameter. Record on the first piece verification record.

B. For AASHTO (DOT's & ESC) 12" – 60" M294 measure the ID with a tape measure or caliper in 8 equally spaced around two (2) samples (sections). Record the sixteen (16) measurements on the first piece form. Average all sixteen (16) measurements and record on the 1st Piece Form. During PII testing measure the ID on 2 of the 3 samples. Average the 16 reading and use this average for the PII test average.

C. For AASHTO M252 (4"-10") measure the inside dia. with a tape measure or caliper at two random positions 90 degrees apart from each other. Do this on 2 samples and add the 4 readings together to get the average inside diameter. Record on first piece form. During PII testing measure the ID on 2 of the 3 samples. Average the 4 readings and use this result in the PII test.

4.2 Pi Tape [method 2] – can be used on non-AASHTO pipe

B. Using a Pi tape, measure around the inside circumference and record the diameter on the first piece verification record. The Pi tape automatically gives the result in diameter.

4.3 Measuring strap [method 2- cont] – can be used on non-AASHTO pipe

A. Using a measuring strap, measure around the inside circumference of the pipe. The measuring strap will measure the length around the inside. Because of this you have to divide this length measurement by 3.1416 (Pi) to get the diameter. Record the diameter on the first piece verification record.

Method 2 – Using a measuring strap or PI tape to determine inside diameter.

4.4 Six Point Tape measure or caliper [method 4] (Used for BNQ and CSA standards. Also, to figure Out of Round). **FOR CANADA PIPE ONLY**

A. Measure inside diameter from seam to seam then measure at five additional locations rotating evenly clockwise from the seams in 30-degree increments.
   a. For BNQ standards: Add both the minimum and maximum measurements from the six readings together and divide by 2 to obtain the average inside diameter record on the first piece verification record.
   b. For CSA standards: Calculate the average inside diameter by taking the average of all six measurements. Record on the first piece verification record.

B. For out of round for CSA and BNQ standards use VM4 section 4.4.

4.5 To measure <u>inside diameter out of round</u> do the following: (for all pipe except Canadian. See control plan)

a. Measure inside diameter at seams

b. Measure inside diameter 90 degrees from seams

c. Subtract Lowest ID from highest ID. This equals ID out of round.

5.0 RELATED DOCUMENTATION

1. Verification Forms

PROCESS	1st Piece Verification Record	SPC Chart
3660	3660- F- 12	
3020	3020-F-1	
UC-250	UC 250-F-3	
260-44	260-44-F-1	
SMOOTH-WALL	SW-F-4	
2" LINE	2-F-9	

2. Standards:

AASHTO M252 (External Document)
AASHTO M294 (External Document)
BNQ 3624-110 (External Document)
BNQ 3624-115 (External Document)
BNQ 3624-120 (External Document)
CSA 182.6 (External Document)

6.0 OUT OF CONTROL

Refer to the Product Control Plan for instructions.

7.0 CHANGE HISTORY

This document was originally issued on September 11, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
12-18-00	TEXT	1
4-13-01	Added procedure for Out of Round	2
9-21-01	Text	3
1-03-02	Added Canadian test procedures	4
9-22-03	Changed AASHTO MP7-97 to AASHTO M-294	5
9-01-04	Added step C and D in 4.1 also added verbiage around F405 F667 in 4.1 A.	6
5/25/05	Add measuring with calipers, remove out of round for heavy duty	7
6-1-05	In 4.2.C added "or calipers"	8
6-16-05	Added step 4.5 to calculate ID out of round	9

1.0 PURPOSE/SCOPE

This Work Instruction is to check the Joint Integrity of HDPE Pipe products in accordance with AASHTO M-294 and M252. All plants that produce pipe products must perform this test to the prescribed frequency established in Work Instruction GEN-WI-001 and the individual Product Control Plans. This procedure covers all joining methods such as Sure-Lok bell & spigot, HI-Q split band couplers, internal and external couplers for small diameter pipe.

2.0 RESPONSIBILITY

The lab or plant test technician is responsible for testing pipe in accordance with this procedure. The technician has the authority to determine the disposition of the pipe based on the test results

3.0 SAFETY

The technician should take care and use all safety equipment mandated when preparing samples for this test.

4.0 PROCEDURE

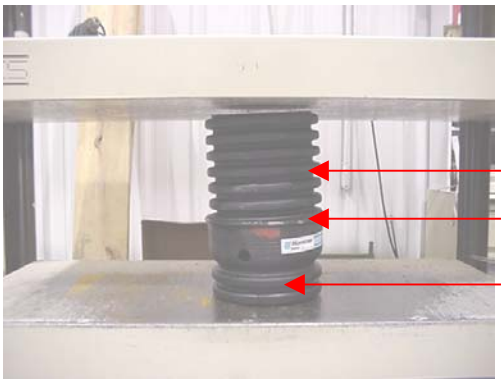
4.1 12”– 60” Diameter procedure

4.1.1 This test will be conducted just like the 5% and 20% pipe stiffness test using the LO-Test machine. It will be necessary for the technician to set up test files in the LO-Test machine for this test. Any questions consult the LO-Test operators’ manual or VM-19 Determination of Pipe PII (12”-60”).

4.1.2 The AASHTO M294 (12”- 60”) specification requires that the assembled joint have an overall length of at least 2 feet. Therefore, the following table will illustrate the minimum number of corrugations the samples should have.

Diameter/Type	Spigot end (# of corrugations)	Bell end (# of corrugations)	Hi-Q or Single wall (both pieces) include a coupler with samples
12”	5	5	7 and 7
15”	4	3	8 and 8
18”	4	3	7 and 7
24”	4	3	5 and 5
30”	2	3	N/A
36”	2	2	N/A
42”	2	2	N/A
48”	2	2	N/A
54”	2	2	N/A
60”	2	2	N/A

4.1.3 If the product is Sure-Lok, you will have to lubricate the bell and spigot to be able to assemble it. Also, you may have to use the LO-Test machine to force the sample together due to the rubber gasket. See picture below.



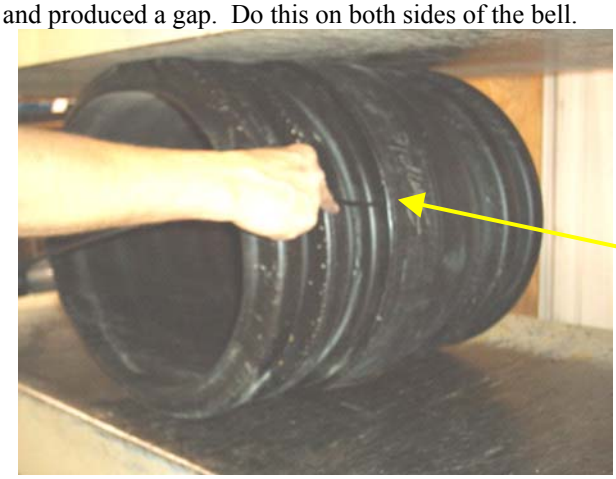
4.1.4 Run the platens at 3 inches per minute so that you can get the sample together quickly. Do not allow the spigot to go too far into coupler. Once the gasket enters be ready to hit the "Esc" key on the keyboard to stop the platens.

4.1.5 Place the assembled joint into the Lo-Test machine.

4.1.6 Select the proper test file from the LO-Test menu.

4.1.7 Run the test as you would a 5% / 20% PII test. Set the test up to run out to 21%. Once the test hits the 20% value (the LO-Test screen will show this), then stop the machine by pressing the "Esc" button.

4.1.8 Insert a 5mm rod between the bell and the spigot. Determine where the gasket would be in the joint then insert enough of the 5mm rod to hit and pass the gasket. If the rod passes thru the gasket, it is a failure. If the rod does not pass thru the gasket, the sample is good. A failure means that the bell opened up at the section shown below and produced a gap. Do this on both sides of the bell.



4.1.9 Record whether the result of the test Passed or Failed on GEN-F-5 QA Test Summary form.

4.1.10 Send the results to the Central Lab, if applicable or when needed for certification purposes. Maintain your records according to the Record Retention Policy at your branch.

4.2 **4"-10"** For pipe supplied in coils (rolls).

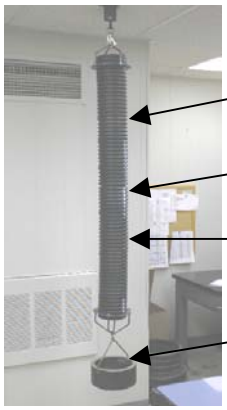
4.2.1 Use pipe samples a minimum of 150mm (6 inches) in length.

4.2.2 Couple two (2) samples together.

4.2.3 Suspend the samples so the pipe length is perpendicular to the floor.

4.2.4 Attach the proper weight to the lower sample (see following chart and picture).

Diameters >>>>>>	3"	4"	5"	6"	8"	10"
Total wt applied to bottom of test sample	6.75kg (15 lbs)	9.0 kg (20.0 lbs)	11.25 kg (25.0 lbs)	13.5 kg (30.0 lbs)	18.0 kg (40.0 lbs)	22.5 kg (50 lbs)



4.2.5 Apply load to pipe specimen slowly. Maintain this weight for 3 minutes. If 3 minutes elapses without joint pulling apart then sample passes. See table below to show what test loads are required for each diameter.

4.2.6 Test three (3) separate couplings.

4.2.7 Record results on Gen-F-5 QA Test Summary form.

5.0 NON-CONFORMING RESPONSE

If the test shows failures, notify the Central Lab, or Branch (if the test is preformed in the Lab) and prepare samples from the same date and blend number for a retest. Follow instructions in Prod-WI-1

7.0 RELATED DOCUMENTATION

ASTM D1693,
AASHTO M252 & M294.
GEN-F-5 QA Test Summary Form

8.0 CHANGE HISTORY

This document was originally issued on 11/1/02 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
9-22-03	Changed AASHTO MP7-97 to AASHTO M-294	1
5/19/05	Changed method of joint Integrity for 12”-60” from drilling hole and using depth gage to using the 5 mm rod technique. Also, added Jt Integrity procedure for small dia. coiled product.	2

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TITLE: Measuring Thickness of Pipe (Average, Minimum, Range and Range at 180°/Die Center)	Revision Date: 08-20-02 Revision: 3	
Issued by: D. Gonso	Approved by: Jo Dible	Date: 9-11-00

1.0 PURPOSE/SCOPE

The purpose of this Work Instruction is to provide a simple explanation of how to measure the wall thickness of corrugated pipe. Accurate measurements of wall thickness are very important. Wall thickness is a dimension that will predict the load carrying capacity of the pipe. The raw material that is used to form the pipe must be in the proper amount (wt/ft) and more importantly must be distributed properly within the walls of the pipe.

All corrugated pipe diameters from 2" – 60" will use this procedure to determine wall thickness measurements for root, crown, liner specifications, gasket groove thickness, and inline coupler thickness.

2.0 RESPONSIBILITY

The 2" line, 3020, 3660, 260-44, smoothwall and UC250 process line operators will follow this procedure. Also, Lab Technicians will use this procedure when checking pipe product during QA Audits and other times.

3.0 SAFETY

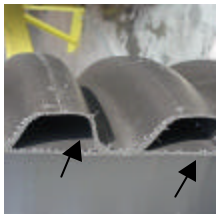
Follow all Hancor Safety rules and Regulations.

4.0 PROCEDURE

4.1 There are two tools that can be used to get the thickness measurements. The Ultra Sonic gage and the 0-1" micrometers. The Ultra Sonic is the preferred tool since it is non destructive and should be used most of the time with the following exceptions noted below.

4.2 When using either tool make sure they are clean and have a calibration sticker that is current. If they are not correct, the supervisor will have them re-calibrated or replace them for you.

4.3 At production start up or blend change you may want to use the micrometer since it is good practice to cut a corrugation off the pipe and look at its cross section to see how the material is distributed. See picture below:



Look for material that is not evenly distributed

4.4 The 0-1" micrometers will be used on the 2" product line, 260-44 product line, smoothwall product line and the UC250 product line since the measuring end of the Ultra Sonic gage is too big. The 3020 and 3660 lines will use the Ultra Sonic gage primarily.

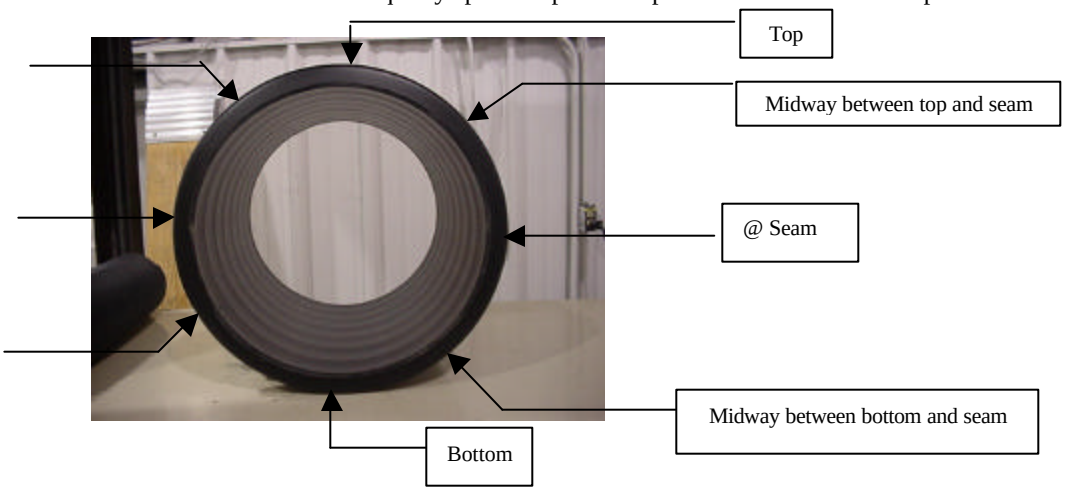
4.5 To find the wall thickness (crown, liner, and/or root) single wall/dual wall measurements of Average, Minimum, Range and Range at 180°.

- 2 inch & 260-44 — Crown & Range at 180°
- UC250, 3020, and 3660 — Crown, Liner, Root, & Range at 180°

Number of Measurements Per:

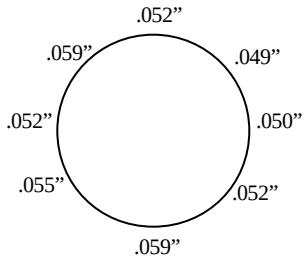
Diameter	Crown	Liner	Root
2”	4	n/a	4
3”- 30” (single wall)	8	n/a	4
4”- 30” (dual wall)	8	8	4
36”- 60” (dual wall)	16	16	8
Smooth wall	8	n/a	n/a

All measurements are to be taken equally spaced a part. See picture below as an example of 8 measurements:



4.6 Record the results on the First Piece Verification Form and /or control charts for each process.

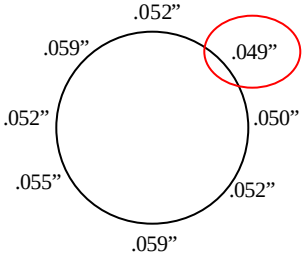
4.7 To find the **Average** add the measurements together and divide by the number of measurements taken.



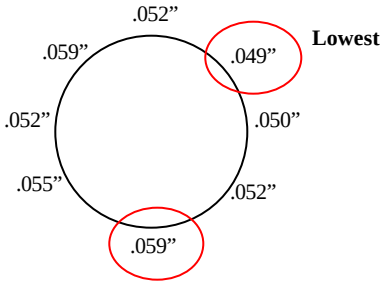
Average = Total of measurements divided by the total of measurements taken

.428 / 8 = 53.5

4.8 To find the **Minimum** look for the smallest measurement taken.



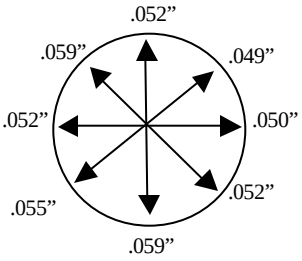
4.9 To find the **Range**, subtract the **lowest** reading from the **highest** reading.



Range = Lowest measurement subtracted from **highest** measurement.

.059” - .049” = .010”

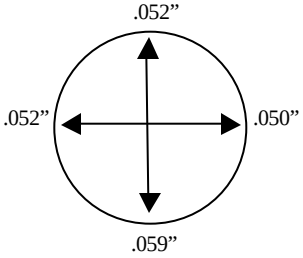
4.10 To find the **Range at 180°** or **Die center**, look at the measurements taken and subtract the two readings directly across (180^0) from each other. The highest number is the **Range at 180°**, sometimes referred to as die center.



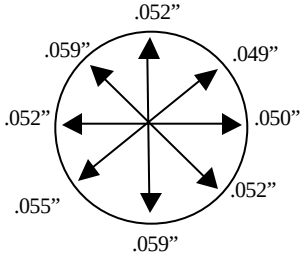
52 - 59 = 7
49 - 55 = 6
50 - 52 = 2
52 - 59 = 7

Range at 180° = 7

4.11 For **Root dimensions** use the 4 readings of top, bottom, and both seams as reference points. For 3660 products use the liner and crown points to get the root dimensions.



3020



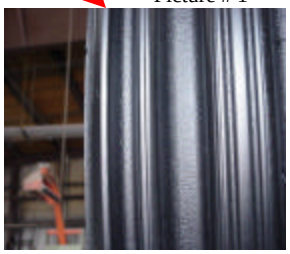
3660

4.12 To find the average thickness of the inline coupler, use the Ultra Sonic thickness gage and measure coupler in the gasket location 4 spaces equally spaced a part. See picture below.

The measurements with the Ultra Sonic gage should be taken in the area where the gasket will come to seat. 4 places equally spaced around coupler

4.13 Measure the gasket groove crown (see picture #1) with micrometer 4 spaces equally spaced a part. Use the stick from the first piece sample to cut the gasket groove section. (see picture # 2)

Picture # 1



Picture # 2

4.14 Record results on the 1st piece verification record.

5.0 RELATED DOCUMENTATION

The following documents are referenced in preparing this Work Instruction:

- Standard Operating Procedure – SOP 10.3 In-Process Pipe Inspection

1. Verification Forms

PROCESS	1st Piece Verification Record	Control Chart
3660	3660- F- 12	Ö
3020	3020-F-1	Ö
UC-250	UC 250-F-3	Ö
260-44	260-44-F-1	Ö
SMOOTH-WALL	SW-F-4	
2" LINE	2-F-9	Ö

6.0 OUT OF CONTROL PLAN

When dimensions are found to be out of specification follow the out of control response in the Product Control Plan. When plotting the SPC chart follow the Product Control Plan and the rules on the SPC chart when a point is out of control.

7.0 CHANGE HISTORY

This document was originally issued on September 11, 2000 at Revision 0. It has been revised as follows:

DATE	REVISION DETAILS	REVISION LEVEL
12-18-00	TEXT	1
3-27-01	Removed calibration of tools at start of start of each shift, also added procedure to check gasket groove area.	2
08-20-02	Text change to clarify range at 180°	3